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Progress Report on HumRRO Research on Project 100,000

by

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HumRRO

The George Washington University
HUMAN RESOURCES RESEARCH OFFICE

Prefatory Note

This paper records a presentation made by a member of the Human Resources Research Office to the staff of Headquarters, U.S. Continental Army Command, Fort Monroe, Virginia, in February 1969. Preliminary findings and background information covering work of HumRRO Division No. 3 (Recruit Training), Presidio of Monterey, California, in connection with Project 100,000, were presented by Dr. McFann, Director of Research at Division No. 3. Research under HumRRO Work Units SPECTRUM, APSTRAT, REALISTIC, and UTILITY, is reported, as are certain Technical Advisory Service activities.

The presentation was one of a series of briefings planned to inform USCONARC of work being done in training and related human factors research and development. The briefings are sponsored by the Office of the Chief of Staff for Individual Training, USCONARC; participants in the series are the U.S. Army Behavioral Science Research Laboratory (BESRL), the Center for Research in Social Systems (CRESS), and HumRRO.

REMARKS

COL E.M. Hudak
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Research and Development Directorate,
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This briefing deals with training of marginal personnel and will be presented by representatives from HumRRO. Among the areas to be discussed are ways and means to improve training of individuals across all aptitude levels, identification of potentially successful and unsuccessful men, and determination of reading, listening, and arithmetic skills required for major MOSs.

Exchange of training research information through periodic presentations similar to that which we are hearing today provides CONARC with a rare opportunity to keep abreast of and gain insight into, the complexity of the Army training system.

An important point to be remembered is that these training research programs are responsive to Army-wide training requirements. We, therefore, solicit your comments and views at any time on how to improve each program. Suggestions and recommendations for application of research products and by-products are especially welcomed.

[The speaker, Dr. Howard H. McFann, Director of Research of HumRRO Division No. 3 (Recruit Training), was introduced by Dr. Meredith P. Crawford, Director of the Human Resources Research Office.]

PROGRESS REPORT ON HumRRO RESEARCH ON PROJECT 100,000

Howard H. McFann

This is an information and progress briefing on the various Human Resources Research Office activities associated with Project 100,000. I will cover the technical advisory service activities with which we have been involved and will emphasize the research we are doing, covering content, training, learning ability, literacy requirements, and on-the-job performance. At the end of this presentation, I will make some summary remarks and try to draw some implications.

Technical Advisory Services

Let me start with the technical advisory service (TAS) activities. I want to emphasize TAS because often past research and experience built up over time play an important part in our advisory activities. When Project 100,000 was being started, we were asked what we knew about training these new accessions men. We had some information, but we had a lot more questions than knowledge. The information we had was brought together in a variety of ways. For example, Dr. Vineberg, one of our staff members, spent about five months working with a team of four people at Department of the Army formulating *Marginal Man and Military Service* (1), an excellent review—I recommend it to you. The review covers prior experience, policies, and previous studies carried out by the various services, going back to the CCC days and including World War II and Korea. Clearly, for a great many years, the military services have had considerable experience with training and utilizing low-ability men.

Another type of information available at that point was from a study (2) that HumRRO had just finished that dealt with how various aptitude groups fared in basic combat training (BCT). The findings were helpful in presenting current quantitative results and in indicating that the concentration of effort should be after basic combat training where there are greater cognitive demands, that is, Advanced Individual Training (AIT), and combat support training. We found, as you would expect, that overall in basic combat training the higher aptitude soldier generally did better, with the greatest difference on cognitive tasks. Although higher aptitude men generally did better on motor skills as reflected in end-of-cycle proficiency tests, Physical Combat Proficiency Tests (PCPT), and marksmanship, the differences between aptitude groups were not marked in BCT and the lower aptitude man generally was meeting standards.

In general, as part of advisory activities, we have tried to bring together relevant information from the inception of Project 100,000 to the present time. The kind of consulting we have done

has been extremely varied, ranging from informal telephone calls or visits from a person who is revising a course, to meetings, informal and formal briefings, to formal reports. We have tried to be responsive and provide information. We have gained much from this interchange because not only has the Army had experience in dealing with low-aptitude men in great detail, but they have maintained careful records. We are learning a great deal that has implications for our research, and in regard to the consulting area, we try, and will continue to try, to be responsive.

Research—Course Revision

There are two types of research activity I wish to discuss. One is the research that has been directly associated in supporting course revision—our Work Units JACK and STOCK. Work Unit JACK dealt with Switchboard Operator's Course (MOS 72C20). HumRRO's involvement in this program was primarily in developing and administering an end-of-course performance test and assisting in the interpretation and analysis of the data. The U.S. Army Southeastern Signal School revised the switchboard operator's course primarily on the basis of more specific performance objectives and employing a functional context approach. This effort is completed and the HumRRO role was of a consulting nature that involved working very closely with the school.

The second effort, Work Unit STOCK, was described in Dr. McKnight's detailed paper given in the Task and Skill Analysis training briefing (3) at USCONARC in October. Work Unit STOCK involved the revision and evaluation of Supplyman Course (MOS 76A10). HumRRO researchers worked in close coordination with the U.S. Army Quartermaster School, a major involvement being completion of a detailed task and skill analysis.

A unique use of the computer was employed with the extremely detailed task analysis. It contained a list of tasks performed by the inventory supplyman, including the requisitioning, the issuing, and the turn-in of material. This was done for each level of supply—unit, organization, direct support, and depot—in which a supplyman might be engaged. Each task was analyzed into the steps required for performance, that is, to the specific behaviors involved. Knowledges and skills required for each task were specified and training objectives were determined. They were sorted into three levels—the minimum objectives that the man must meet in order to pass the course; the advanced objectives that are desirable but not mandatory; and on-the-job training objectives best learned on the job, but for which there would probably be prerequisites during the training course. Performance standards were indicated, in terms of the time required, the accuracy required, and the reliability with which the man should be able to perform the task. For each requirement, the source document (e.g., Army Regulation or Training Manual) from which the requirement was established was indicated on an IBM card. Also, beside each task element a notation was made giving the page and number of the lesson plan where it could be found.

What is important from a training viewpoint is that the use of the computer in this way allowed for ease of course formulation, revision,

and modification. Also, in the future when new requirements arise, it is going to be easy to determine what changes are required in the whole program and to locate relevant documents. This, I think, was the most innovative part of the whole task analysis.

In addition to the Task and Skill Analysis, HumRRO personnel worked with the U.S. Army Quartermaster School in developing the program, organized along a functional approach, assisting in developing the performance tests, and in the evaluation of the program. Using a functional approach to training, I think, is critical and is an approach I am going to mention three or four times in this paper. This is one of the few principles we know that works in increasing the likelihood of a so-called lower aptitude man (as judged by the Armed Forces Qualification Test) making it through a course. Functionalizing training content makes the material much more job related and much more practical in nature.

Long-Range Research

In the longer-range research, our first Work Unit is SPECTRUM, the development of procedures for selection of training content and training methods to achieve more effective training at all aptitude levels. This Work Unit has been divided into three phases; two of them are completed. The Work Unit is an effort sponsored by Research and Development, Department of the Army that had been started shortly before Project 100,000 really got under way. The effort took on a greater emphasis as the Project 100,000 people were brought into military service and has taken on a further emphasis as more college people are being brought into the Army.

The first phase of this effort was primarily a survey of the present system. We examined combat support training primarily to determine how well the various aptitude groups were doing within the existing programs and to isolate problems if any were found to exist. Table 1 gives some summary information. On the left are AFQT groups I, II, III, and IV, with the new accessions people in IV shown separately in the final entry; next, the number of people who started a course, the number who graduated, and the percent who graduated. This is the number of people who were successful the first time; you know, most of the people do make it through eventually.

A way of looking at training is that if it is necessary to recycle, training costs and training expenses are incurred. It is apparent that at the Category I level 98% made it through the first time. However, when you get down to the new Category IV accessions people, 52% make it through the first time. My point is a very simple one. Existing courses were not geared for these low-aptitude people. This is reasonable, as the courses were developed primarily after World War II and Korea for input of Category II and upper Category III people. As a result of our examination, I think it is a fair conclusion that no one single course—a single track system that deals with a particular media and method—can be equally effective for all aptitude groups. I will discuss this further a little later.

Table 1

Students Graduating From Selected Combat Support Training Courses, Without Recycling, by Armed Forces Qualification Test (AFQT)

AFQT Group	Start	Graduate	Percentage
I (93-99)	89	87	98
II (65-92)	406	375	92
III (31-64)	551	488	89
IV (16-30)	238	182	76
IV (10-15)	25	13	52
Total	1309	1145	87

The second SPECTRUM subtask was a laboratory study. The purpose was to determine the relationship between mental ability, as judged by the AFQT, and the learning of military skills and knowledges. As shown in Figure 1, we developed tasks from very simple to complex. They ranged from (a) simple stimulus-response associations such as a simple and choice monitoring task that require almost no learning; to (b) more complex *fixed-procedure* tasks such as getting a particular piece of equipment in operational order and also rifle assembly and disassembly tasks; and (c) use of concepts and principles at a much more complex level, such as a specific task involving an intersection problem in position plotting (the trainee had to learn to use range and bearing before plotting his position).

Let me summarize our procedure and findings: We used a high-, middle-, and low-aptitude group selected from the top, bottom, and right out of the middle of the AFQT distribution. We designed our training as best we could to individualize it and make it especially

Ordering of Tasks Along a Dimension of Complexity

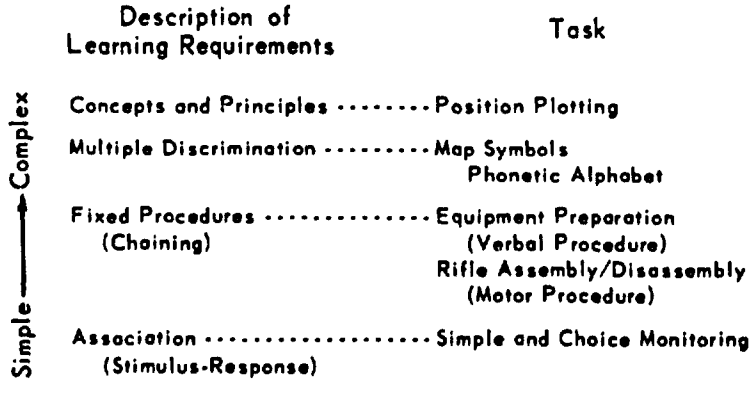

Figure 1

fitted for the low-aptitude man. There was a one-to-one student/teacher ratio. There was extensive use of video-type material, immediate correction of wrong responses, provision for feedback, and small instructional steps. In short, training was geared as much as possible to the low-aptitude man. Figure 2 shows summary curves that typify our findings. In each instance the light line refers to the high-aptitude man and the dark line to the low-aptitude man.

Learning Curves for High- and Low-Aptitude Men

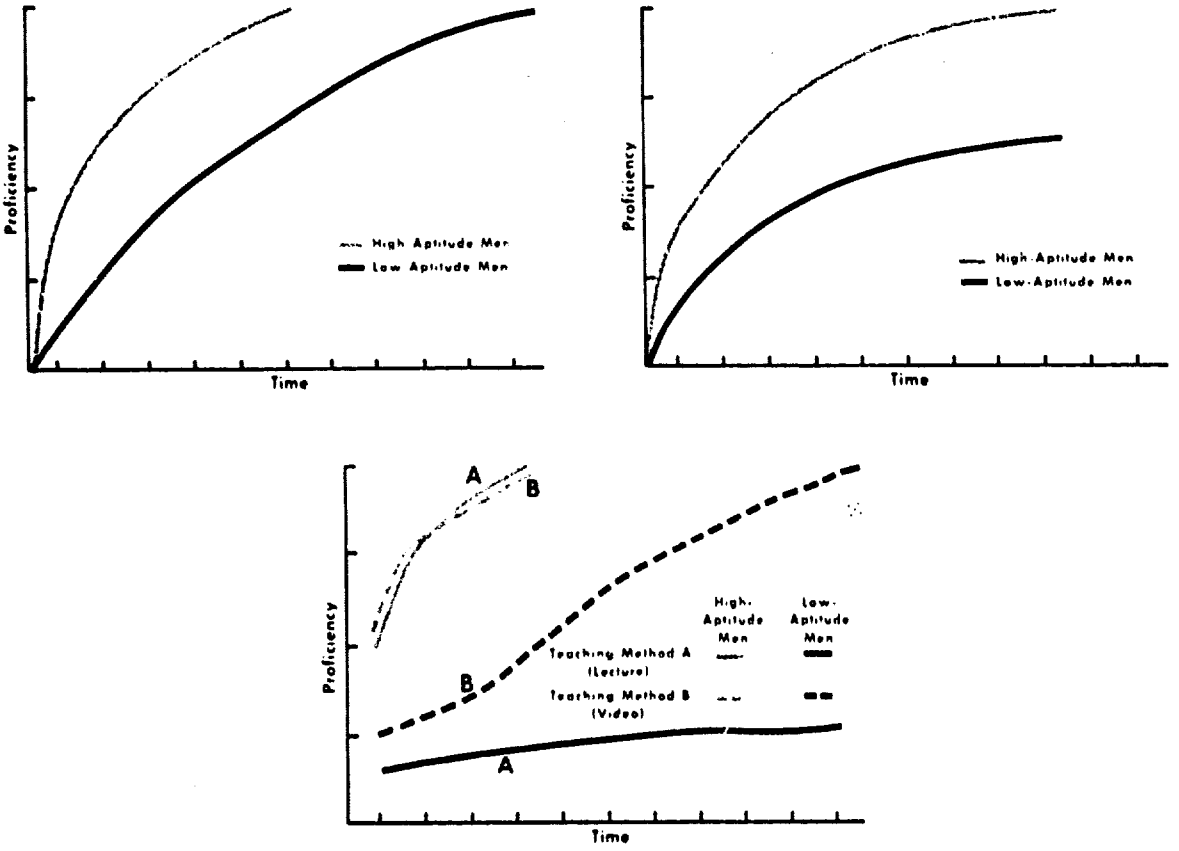

Figure 2

We found that for some of the tasks both groups learned, but it took the low AFQT group from two to four times longer to learn to perform. On some of the other tasks, from all indications the low-aptitude group, as a group, was not mastering the material and would not do so, as far as we could see, in the time available.

Consistently, in the low AFQT group, we found great variability. I think that this is a very important point in that it indicates many are labeled "low" but are very good performers. Obviously, one of the key problems is to identify these people. Further, I think this variability has implications when grouping people on the basis of AFQT.

The last curve emphasizes the importance of method of instruction. On the map instruction problem, we tried two lines of instruction for

high and low AFQT groups. Method A was primarily a lecture method, a platform type of presentation. As shown in Figure 2, all indications were that the lower aptitude group was never going to learn. We then switched to Method B and utilized more of the video-type approach, using feedback, small steps, and practical exercises. With this method, many in the low AFQT group learned to perform successfully. I think the most important points are that the high-aptitude group under each method learned equally well, but methods for the low-aptitude people became critical as to whether they learned at all. Nevertheless, it took about six times as long for the low-aptitude people to learn the material as it did for those of high aptitude, but they *did* learn.

In general, our results showed that depending on the particular task, low-aptitude trainees required from two to four times as much training time, from two to five times as many training sessions, and up to six times as much prompting and instructor intervention as did the higher aptitude men. Also, the low-aptitude trainees were found to be decidedly more variable in their learning performance than the men of higher aptitude, as judged by the AFQT.

We also assessed the performance of low-aptitude men in a variety of other nonlaboratory measures such as the Army Classification Battery (ACB), their scholastic achievement, and their performance at the end of BCT. We found the same pattern of results as indicated by our research. Our conclusion is that AFQT score has very important implications for the efficient conduct of training.

In the third phase of SPECTRUM, where we are working at the present time, we are trying to provide information for use in developing training strategies appropriate for the various levels of aptitude by studying the proper mix of instructional methods for particular levels of aptitude and type of task to be learned. For instance, it is likely that although training strategy "A" will be optimum for training high-aptitude people, strategy "B" should be used for low-aptitude people. Further, maybe training strategy "B" is great for low-aptitude people on complex tasks, but when it is a simple task, one may want to use quite a different strategy. In order to determine the proper mix, we are studying instructional methods, trainee aptitudes, and task complexity or difficulty, and trying to deal with all three factors at the same time.

There will be a series of laboratory studies to examine values of each of these kinds of factors simultaneously. As a laboratory vehicle for conducting our studies, we developed what we call a miniaturized training program. It lasts about five days and is composed of a variety of learning tasks selected from the high-density combat support MOSs and representing several levels of complexity. The program is constructed as an interrelated, progressively developing, training sequence, so that it makes sense to the trainee as he goes through it. He sees it as a meaningful activity, dealing with military tasks that have utility, rather than as an assemblage of short, unrelated tasks as in SPECTRUM II. The generality of that study is limited because the tasks were of shorter duration and were not really related.

The miniaturized training program is centered around the operation of a message center and includes field wire technique, switchboard operation, use of clerical forms, updating procedures for tactical maps, and the processing of messages. We tried to formulate a variety of kinds of activities but ones that can be put together and have high face-validity. There are some 20 to 30 interrelated tasks making up this program, ranging from simple verbal and motor procedures tasks, such as field wire splicing, to highly complex tasks requiring the use of principles, such as using grid coordinates to plot position on tactical maps.

In each study of the series we plan to conduct, we will be assessing the effects of various combinations of instructional variables. Let me give you some examples of variables: (1) Instructor density—it appears from what we know so far that especially for the low-aptitude man, more instructor intervention and assistance are needed. This becomes very relevant—how many people can an instructor deal with effectively? (2) Sequencing of content—using the functional approach or a subject-matter approach. (3) Rate of presentation. (4) Repetition of information. (5) Whether or not self-instructional material is used. (6) Choice of media. This is a very important area. The new accessions men on the average are able to read at about sixth-grade level, but range from functional illiterates to about tenth-grade level. It is apparent they get a great deal of their information from listening. Obviously, TV has a very important role to play in this area. We need to really use these kinds of techniques and try them out in various ways.

Our general approach is to start with people labeled "low aptitude" by the AFQT, and then work up the scale. We will first try to devise training methods that will work at the low AFQT level since this is where the problem is. If we develop approaches that work at this level, we will test to see what kind of adaptations have to be made, if any, for Category III or Category I levels going up the scale. Right now we have developed the material and are developing instructional approaches.

Let me next describe Work Unit APSTRAT,[1] as it has relevance for what happens in the field. Its objective is to develop instructional systems appropriate for a wide range of aptitudes and test the systems in an operational setting. Much of the SPECTRUM research is involved in trying to get a "fix" on various kinds of instructional variables and their potency. However, as you know, solutions that work in a laboratory or in a controlled situation may not transfer or be effective in an operational setting. APSTRAT, to a considerable extent, focuses on the operational situation.

There are three facets to the APSTRAT research:

First, we want to deal with an operational setting. We want a standard input to the course—the type of people who would normally be sent to the course. We want the same type of instructors, not especially selected.

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[1]Sponsored by Assistant Secretary of Defense (Manpower); Deputy Chief of Staff for Personnel, Department of the Army.

Second, we are re-engineering the course along a functional basis and trying various media. We will obtain a great deal of information from SPECTRUM, as well as information from other sources, and will develop a multi-media program.

Third, we also are attempting to introduce and evaluate the effectiveness of various incentives—incentives that are meaningful, feasible, and effective. There has been a great deal of talk about incentives but to my knowledge rarely have incentive systems been tried out in an operational context as complex as the Army has to face. We know that contingency management, a form of payoff or reinforcement on a very careful schedule, works very well; but so far, contingency management has been utilized with a ratio of two or three people to an instructor. How can we use this very effective principle on a large scale? Can we find ways of using it within the Army context?

The Field Wireman Course (36K20) has been selected for this research for a variety of reasons. It is representative of tasks and has good spread in tasks. Historically, there is a good range of aptitude as far as input. Another good reason is that we are located in the Fort Ord area where this course is fairly available now and will be for a period of time.

To date, we have systems engineered the course according to USCONARC Regulation 350-100-1. We have put our information on a computer consistent with the method used in Work Unit STOCK. We have determined the job duties for the various duty positions, and then determined the objectives, skills, and knowledges required, and have also stated the standards.

The instructional approach we are taking is quite different from the existing one. One way of describing our approach is to label it a "functional problem approach." We are combining the various objectives into problems that are related to various job duties a wireman would have to perform. For example, we provide material such as two phones and some wire and require the trainee to get a message over these phones; he has to connect the phones and get the message through. The problems progressively get more complex. The idea is to make the problems much like a work order that a wireman would receive. Thus, the trainee would get job practice; it is a simulation of the real world of work, so to speak, for him.

The objectives combine into around 30 to 40 problems, going from very simple to very complex. So far we have developed most of the problems and are now in the midst of developing multi-media so that for a specific problem, various media will be available for the trainee to use. For example, the high-aptitude person may select programed instructional material written for him while the low-aptitude person may lean much more heavily on the instructor and on the audio-visual type material.

We are starting work on the development of incentive systems that we can put into effect. Informal discussions have occurred with the Commanding General, Fort Ord, and his staff as to possible arrangements to permit this research. As a result of these discussions, a formal

request is currently being processed to USCONARC through Fort Ord to give us instructional control of the wireman's course for a period of time. Control would include methods, media, instructor role, and incentive systems.

Once the program is developed and incentive systems agreed to, we will initiate an instructor training program followed by a series of tryouts of the program. We will have to do a great deal of instructor training—I think it is going to be one of our major concerns. We will try out the program on a single class and then move toward having a new class start each week. Eventually, we will have classes back-to-back consistent with existing operational procedures. Thus, we would have information on running this course in a normal operational context with classes back-to-back and normal instructor turnover.

I now will turn from training into the next effort—Work Unit REALISTIC,[1] which has the objective of determining literacy skill job requirements and assessment of literacy level of personnel. The word REALISTIC refers to reading, listening, and arithmetic; we are determining the levels of these skills required for satisfactory performance of essential job duties. Also, we are trying to develop guidelines and methodologies for reducing discrepancies between personnel skill levels in reading, listening, and arithmetic, and levels of these skills required by the job.

Our approach is to test personnel to find out what their present reading, listening, and arithmetic capabilities are and relate these to job performance—a psychometric, or prediction, approach. I will say more about the particular performances when I discuss Work Unit UTILITY. Various on-the-job materials required for the man to perform the job are being examined (communication type material, manuals, etc.). We are also examining training material to determine existing levels of difficulty. We are including in the training both written and oral communication. Listening is emphasized because it appears to be so important in instructing soldiers who have problems in reading.

Some data we have collected are presented in Figure 3. Reading grade level of material was obtained by employing a standard formula called a Flesch count, which takes into account sentence length and number of syllables in a word and yields an approximate grade-level difficulty. For example, 16th-grade-level material would require post-college average reading level or difficulty level. In the first bar in each instance, we have an indication of the readability of publications; we have selected various Field Manuals and Technical Manuals that a man is supposed to be using and determined their average difficulty or complexity level. This has been done for the various MOSs indicated.

The second bar represents average reading ability for Non-Category IV men who are on the job, and the third bar shows average reading ability

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[1]Sponsored by Assistant Secretary of Defense (Manpower); Deputy Chief of Staff for Personnel, Department of the Army.

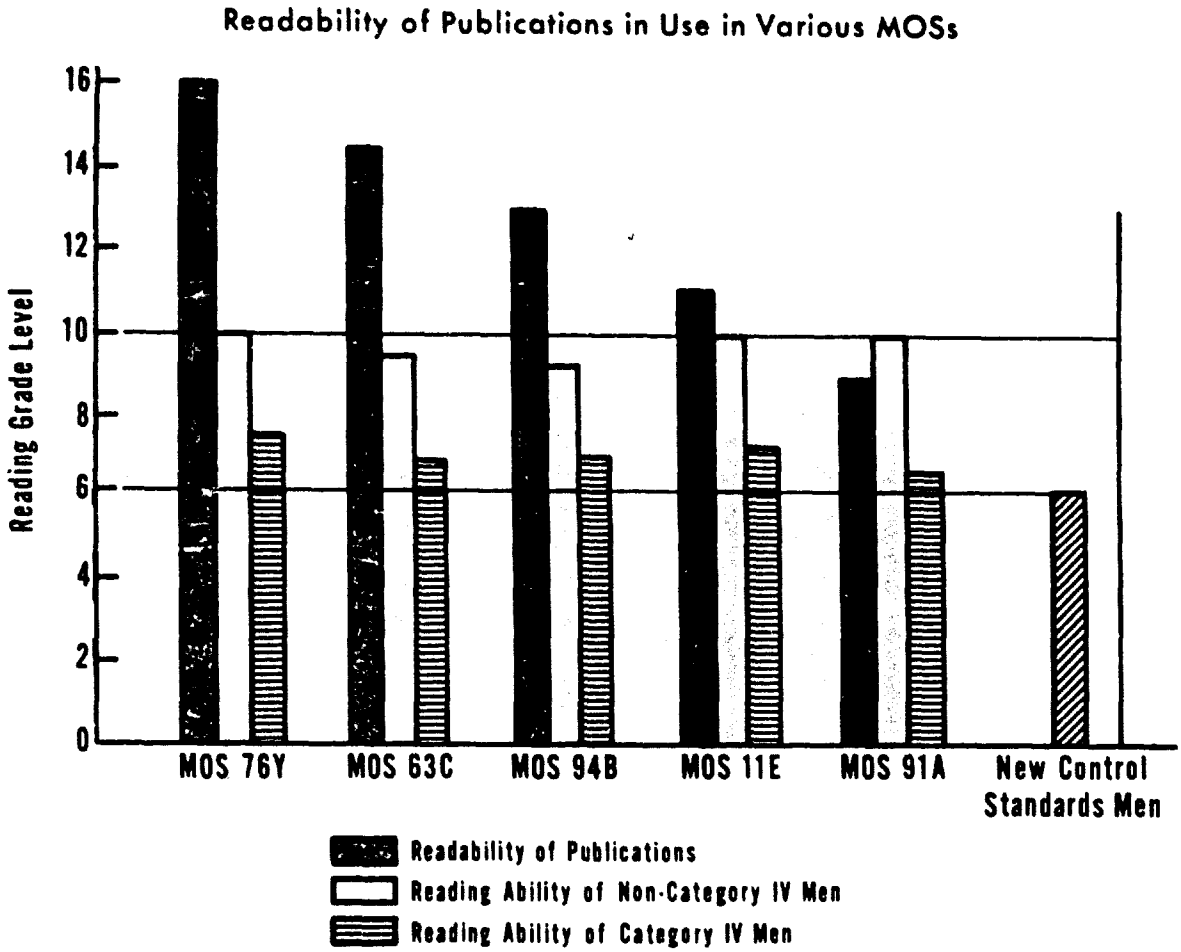

Figure 3

for Category IV people on the job. The bar at the far right shows reading-level data obtained by Department of Defense on about 45,000 new standards men. The data show a considerable discrepancy between the reading level of the men and the reading level required for the documents.

For example, the supply manuals are written at a 12th-grade-complexity level while the reading capability of the Non-Category IV people is at about the tenth-grade level. For the medical MOS (91A), it is interesting to see that there is a closer match—the material and the men are in closer relation. One of the reasons for these differences may be that a considerable amount of the material written in supply deals with legal aspects and thus introduces more complexity.

These data do not record anything about how the man performs on the job. All they show is that the material, in terms of level of difficulty and complexity, does not "match" with the men who are supposed to be using it. The question becomes one of what do you try to do—raise the people up or lower the material? The emphasis we have taken so far is to see whether we can reduce the complexity level of the material.

What we are trying to do at this point in time is to relate literacy level to on-the-job performance. How do they really perform? Also, as I have indicated, we are looking at the training material to see to what extent it agrees with on-the-job material. We also are studying the use of procedures for improving performance through listening. As research indicates, listening performance can be improved. Data we have so far clearly indicate that not only are low-aptitude people poor readers, they are also poor listeners, even though a good number get most of their information through listening. Generally speaking, they are better listeners than they are readers, but there still is a big discrepancy between their performance and that of the higher-aptitude men.

Now to describe the last Work Unit, UTILITY,[1] which is concerned with on-the-job performance. The work unit objective is comparison of job performance of Category IV and Non-IV personnel; identification of characteristics of successful Category IV men; determination of measures useful for screening and classifying.

The design of the study is basically one of comparing on-the-job performance of Category IV and Non-Category IV people for five different MOSs—the same MOSs on which we have reading data. The MOSs, selected on the basis of guidance from DoD, were to have counterparts in the other services, and also, ideally, counterparts in civilian society. Clearly mechanics, clerks, medics, and cooks meet these requirements. Also, we included a combat MOS—armor crewman. We chose this MOS because, in addition to representing a combat arm, it involved a team.

We are collecting data on about 1800 people. Our criteria data are of several types. First, each man is being tested on an individual basis in especially developed performance tests; second, paper-and-pencil knowledge tests are being administered. The paper-and-pencil test scores will be compared to performance tests to determine what relationships exist. Third, we are obtaining supervisor ratings. In addition, we are getting much information on rate of progression in grade and on misbehavior history.

We also have matched men for each MOS on "time" in MOS or how long the man has been on the job. Category IV and Non-Category IV men are matched on time in MOS, from zero to four months, from four months to 12 months, and from 12 months beyond. Time in MOS may become important since it may well be that a man does not perform satisfactorily when he arrives on the job, but that after he has been on the job a while, he "settles in," learns, and does an admirable job. I think this factor is going to be very important and have implications for our training.

In addition to these criterion variables, we are collecting information on a considerable number of predictor, selector, or control variables of two types: (a) factors that are given—that the Army cannot do anything about—such as age, AFQT, ethnic background, and socio-economic situation; (b) factors that are amenable to modification by

[1]Sponsored by Assistant Secretary of Defense (Manpower); Deputy Chief of Staff for Personnel, Department of the Army.

the Army, such as MOS assignment, school trained or not, and rate of progression. Further, as predictors, we are collecting information related to personality variables, and intelligence tests, to include nonverbal cognitive type tests.

On Work Unit UTILITY, up to the present, we have collected data at Fort Ord, Fort Hood, and Fort Carson. Data collection is completed on cooks and mechanics and about halfway completed on the medics. We also have about three-quarters of the data collected for the supplyman and about half of it for the armor crewman. We should be finishing our data collection by the end of June.

In summary, in all of these four long-range research work units, we are obtaining background information and characteristics of the so-called "marginal" man. We need to understand more about the subgroups within this population. Clearly UTILITY and SPECTRUM I will provide information of this sort. In SPECTRUM, where we were able to control variables quite carefully, we obtained information via laboratory-type studies on learning and performance capabilities of various subgroups.

In SPECTRUM III, with the miniaturized training courses, we will have more detailed information on effectiveness of various instructional methods and media for various types of content and for various aptitude levels. In APSTRAT, we deal with multi-media, aptitude difference, and incentive systems in an operational context. SPECTRUM and APSTRAT emphasize training. Within Work Unit REALISTIC we are studying the relation of literacy and job requirements, and also getting background material and information relevant to design of written material for both training material and on the job. Ultimately, of course, the key questions go to Work Unit UTILITY where we are concerned with aptitude difference and on-the-job performance.

General Conclusions and Implications

Let me draw three general conclusions and then state some implications for action, as I see them. The general conclusions are:

(1) The training system should be modified to better cope with individual differences.
(2) The first-priority modification should be developing procedures to better train the low-ability man. This is the key problem.
(3) There exists a significant disparity between readability of publications and capability of many job incumbents to use them. Research data show that publications can be modified to be made more understandable.

Now what are the implications for actions that might be taken? I will start with a "Blue Sky" one and then move down toward reality. The most general implication, mentioned in various sections of this paper, is:

(1) The ideal training system would be so designed that the instructional program would—
    (a) Be based upon actual job requirements.

(b) Match organization, sequencing of material, instruction methods, media, instructor role, and incentives employed with capabilities, and characteristics of each person.
(c) The individual soldier would master the training and reach job proficiency in a minimum amount of time.

If somebody said "do this," we don't know how at this point in time. I don't think anybody knows how to do it. And even if we did, I'm not sure it should be done because I think there are real questions on desirability. This is where we need to get data and very careful data. As you individualize, as you attempt to increase flexibility, you increase management problems at some rapid rate. Where individualization has been worked out, such as in the individualized instruction in the public schools, the approach has been very effective. Also, many problems have developed as people have tried to individualize when they have not sufficiently considered the management problems. There is always a real question—is the gain worth the cost?

Let me now mention some implications that I think are possible and could be done. Some of them are being done. These are specific implications aimed at the second conclusion, on the development of better procedures in the training of low-ability men. I think this is the first order of business, and can be approached in several ways:

(2) *Systems Engineering* according to USCONARC Regulation 350-100-1. Systems engineering has been shown many times to be very effective and is also compatible with the longer-range concept of individualizing training. The result will be to insure (a) that materials will be job related, (b) specific behavior will be stated, and (c) standards established.

(3) Functionalization. This involves organization and sequencing of material. We know it works for low-aptitude men by making the material much more job relevant and meaningful. Let us get away from this subject matter training and put it into task- or problem-type training—a functional type of training. In functionalizing, training becomes more practical and this is very important when trying to train the lower aptitude soldier. It appears that, generally, they need a more concrete type of experience in training.

(4) Concept of Mastery. To insure that at each step along the way the low-aptitude man gets the material, introducing the concept of mastery is essential. Let's not wait until the end of the course and then find that we have to recycle him. Experience shows that especially in the case of the low-aptitude men, they will not tell you what the problems are. Those in charge don't know the problems until it is too late. Introduce concepts of mastery and introduce a performance emphasis, then both the trainee and trainer have information on progress and the places where learning problems occur. As the low-aptitude man experiences some mastery, he can get some self-confidence, and I think there will be a substantial positive cumulative effect.

A different order of implication after the system engineering, functionalization, and mastery have been done, is:

(5) Development of procedures to allow for acceleration for the more capable higher aptitude person. As I have mentioned, as soon as the concept of acceleration is introduced, so are management problems. One of the worst things one can do is to introduce the concept of acceleration and not have a place for the person to go. Obviously, all a trainer has to do is to have a trainee get through early and then have him placed on detail because he cannot progress to another phase, and that is the end of acceleration.

There are some things one can do with the early graduate when one allows for acceleration. The man who finishes early can be used as an assistant instructor in a tutorial role; this has been done in the Army and it works. A second possibility is to move the trainee to an advanced course such as the Adjutant General School tried out in a program for clerk and clerk-typist; when a man finished the clerk course early, he was advanced to the clerk-typist program. Another example is in leadership programs where, depending on the individual's performance, he goes to special courses.

Clearly, there has to be a reason for the student to want to get through, and there has to be a place for him to go. Obviously, if the course is long enough, the early graduate can get on the job faster, but since most of our research has been dealing with AIT and combat support, course length and the Public Law 51 place constraints on this possibility. One possible approach for combat AIT would be to further train the individual, for example, it is conceivable that a man in the infantry could be trained on both direct and indirect weapons rather than only one. Obviously, the result would not only be a better trained man, but also there would be greater flexibility in his assignment and use.

(6) The last implication is related to publications or manuals. I think modifications need to be started. I'm not sure it is simply modifying "FMs or TMs." I'm not sure that is what needs to be done or that this is a feasible approach. What may be required is the development of special training pamphlets or job-aid material that "translates" the formal documents. I suspect it would be much easier to introduce new material than it would be to markedly alter FMs and TMs. Training and job-aid materials have been developed and found most useful, for example, especially designed electronics maintenance manuals were found to be effective both for training and on the job (4). Special manuals were tried out for Armor AIT training of armor crewmen and have now become part of the Army inventory (5). That effective manuals and pamphlets can be designed is clear; the problem now is to determine guidelines for how this should be done so we don't have to operate on an *ad hoc* basis.

DISCUSSION PERIOD

[Following the formal presentation, a discussion period was held. Questions and answers that dealt with elaboration of the formal presentation are not reported; a synopsis of other questions and answers follows.]

Question: What information have you collected on forgetting and ability level?

Answer: To date we have only a smattering of information on this topic. In SPECTRUM III, we will be able to obtain more systematic information. In one study, STRANGER III, we trained high and low AFQT men on a 92-step *procedural* task that involved putting a control panel into operation. The results show no difference in forgetting rate for high and low men over a period of six to eight weeks. A key problem in studies of this sort is to insure that individuals are at the same level of performance at the end of training, as otherwise one can obtain quite an artifact. Some studies on forgetting have involved the same amount of training or learning time rather than a performance criterion or a certain level of mastery. As I recall the general data on forgetting, the results support the conclusion of no difference on ability level. Further, the data tend to support that forgetting is less on motor skills than on cognitive information. However, several methodological questions are raised as to comparable levels and the measurement of both motor skills and cognitive activities.

Question: Is there anything gained and have you considered, a selective mix of Category IVs and Non-Category IVs?

Answer: A study was done a few years ago at Fort Knox involving a mixture of highs, lows, and highs and lows, and then incentives were introduced also. The thought behind this was that with the high and the low men together and with the use of group incentives, the more capable man will work with the low man and bring him along. The main effect that showed was the use of incentives and this effect may have been so strong that it overrode the variable of mix since no differences were found on mix. What is an appropriate mix is one of the questions needing an answer, and constitutes part of the information we hope to obtain in Work Units SPECTRUM and APSTRAT. One of the problems in grouping is on what basis do you group? If you group on AFQT, then our data would indicate that you would obtain group effects but you would be misclassifying a substantial number of low AFQT men. As you will recall, we found great variability in our low AFQT group on every task. Further, there is the question of "expectancy." If I am placed in a low group, then there may well be a self-fulfilling prophecy operating. If I am expected to do poorly, then I will so perform. Presently, I favor either heterogeneous mixing with grouping to occur on the basis of the individual's performance or grouping on the option of the individual.

Question: [Information was provided on recent attrition rates in various types of courses.]

Answer: [First, a request was made for receiving copies of these data since they would be most useful.]

For the high-skill courses, it would be ideal if *specific* entry requirements were known and men selected on their possession of these requirements. Clearly, if a course requires 12th grade mathematics, it is impractical to put someone into the course who does not have these skills or knowledges. Consistent with what I have said earlier, I think many of the low AFQT men could learn to do the mathematics although they don't possess such knowledge or skill at time of entry into the service. A key question is whether we are going to invest the time, effort, and expense to get these men up to an acceptable entry level.

Some comment may be made on the use of attrition rate as a measure of success in a course. A measure that we have found to be very useful is recycle rate in addition to attrition. I feel a better estimate on training efficiency is obtained by collecting information on how many men make it through a course the first time and how much recycling is required, as well as overall attrition rate. For example, in doing research in the Radio Operator's Course (05B), there was a substantial increase in a weekly input of Category IV people. Attrition rate went up but not nearly as high as did recycle rate. In general, I favor functionalizing courses since we know the result is positive, especially for the low-aptitude man. I favor introducing mastery of material throughout the course which would allow for identification and, hopefully, rectification of a learning problem when it occurs.

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13. ABSTRACT

This is a report on the progress of HumRRO activities associated with Project 100,000—Work Units SPECTRUM, APSTRAT, REALISTIC, UTILITY, and Technical Advisory Service. Preliminary findings are described, including certain background information concerning Project 100,000 personnel. Training factors, learning ability, literacy requirements, and on-the-job performance, are covered. Three general conclusions are (1) The training system should be modified to better cope with individual differences; (2) The first priority modification should be with developing procedures to better train the low-ability man; (3) There exists a significant disparity between readability of publications and capability of many job incumbents to use them.

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